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USARIEM TECHNICAL NOTE 91-1

SUSTAINING HEALTH AND PERFORMANCE IN THE DESERT:

Environmental Medicine Guidance for Operations
in Southwest Asia

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U S ARMY RESEARCH INSTITUTE
OF
ENVIRONMENTAL MEDICINE
Natick, Massachusetts

DECEMBER 1990

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UNITED STATES ARMY
MEDICAL RESEARCH & DEVELOPMENT COMMAND

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SUSTAINING HEALTH AND PERFORMANCE IN THE DESERT:
Environmental Medicine Guidance for Operations in Southwest Asia.

Prepared by the Staff of the U.S. Army Research
Institute of Environmental Medicine

December 1990

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US Army Research Institute of Environmental Medicine
Natick, Massachusetts 01760-50007



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SUSTAINING HEALTH AND PERFORMANCE IN THE DESERT:

Environmental Medicine Guidance for Operations in Southwest Asia.

FOREWORD

On 8 August 1990, the staff of the U.S. Army Research Institute of Environmental Medicine (USARIEM) responded to a request for information from deploying units and began preparation of summary guidelines and principles for environmental medicine support to desert operations. A 16-page summary paper entitled, Environmental Medicine Support for Desert Operations: Practical Guidance and Suggestions for Deployment & Survival, was completed on 10 August and forwarded to the Corps Surgeon of the XVIIIth Airborne Corps. Subsequently, this document received wide distribution and served as a key source for similar guidance distributed by other services, as well as NATO. At the request of the Office of the Deputy Chief of Staff for Personnel (letter from DAPE-HR-PR, dated 30 October 1990, subject: Distribution of Medical Information to Deploying Units), we have prepared this expanded technical note for Army-wide distribution.

The guidance and suggestions presented here draw heavily on knowledge gained by this Institute in laboratory and field studies, information obtained from contacts in other countries, and observations made by Institute personnel who have accompanied troops deployed to desert environments for training and readiness exercises (e.g., Bright Star, National Training Center). This paper is not intended to replace policy and doctrine established by Headquarters, Department of the Army, Training and Doctrine Command, Forces Command or Central Command, or contained in Technical Bulletin Medical 507 (TB Med 507) and other official publications, but to make available this Institute's "lessons-learned" expeditiously.

We encourage readers to provide critical comments and examples of their own "lessons-learned" during operations in Southwest Asia to:

COMMANDER
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ACKNOWLEDGEMENTS

This document is the joint effort of the staff of the U.S. Army Research Institute of Environmental Medicine (USARIEM), under the command of Colonel Gerald Krueger, Ph.D.

The following individuals contributed significantly to the content of this document: Lieutenant Colonel Robert Burr, M.D. - Medical Advisor to the Commander; Dr. Roger Hubbard, Ph.D. - Director, Environmental Pathophysiology Directorate; Major Mary Mays, Ph.D. - Chief, Military Performance and Neuroscience Division; Captain Robert Moore, Ph.D. - Military Nutrition Division; Lieutenant Colonel Bruce Jones, M.D. - Chief, Occupational Medicine Division; Dr. Andrew Young, Ph.D. - Thermal Physiology and Medicine Division; Mr. Lee Stroschein and Mr. William Matthew - Biophysics and Biomedical Modeling Division; Captain Dana Scott, D.V.M. - Comparative Physiology Division; Lieutenant Colonel William Curtis, M.D. - Thermal Physiology and Medicine Division. Lieutenant Colonel J. Frazier Glenn, Deputy Commander, served as senior coordinating editor, and is responsible for the layout, format and consolidation of editorial review comments into the final document.

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A special debt of thanks is owed to Dr. Edward F. Adolph and the members of the Rochester Desert Unit (1942-1945), whose pioneering research under military contract (OEMcmr-206) during World War II laid the firm foundation for this document. Interested readers are referred to Dr. Adolph's book, "Physiology of Man in the Desert," Interscience Publishers, Inc., New York, 1947. We would also be remiss if we failed to acknowledge the contributions of the many soldier volunteer test subjects who participated, often under harsh and demanding conditions, in the laboratory and field studies which form the basis for our guidance and recommendations.

Responsibility for final determination of content and editorial review rests solely with the Commander.

INTRODUCTION

Southwest Asia (SWA) is a harsh and unfamiliar environment for American soldiers. SWA poses a set of hazards unfamiliar to most of the leaders and soldiers who have trained in the temperate and hygienically advanced environments of CONUS or Europe. The primary environmental hazard of SWA is the desert, which has a climate that spans from hot-dry to cold-damp depending on the season and time of day. Yet, there are also coastal areas featuring marshlands which increase the risk of cold injury during the winter. This technical note discusses the environmental hazards of SWA and how to deal with them.

****REMEMBER****

***People have lived successfully in SWA for thousands of years.
American soldiers can do the same.***

Armies have operated in SWA for thousands of years. Some have been successful and some have experienced disaster. An important difference between success and disaster has been the degree to which armies have stayed fit and healthy in the face of the disease and injury threats of SWA. **Your success and your unit's success will depend on your staying fit and healthy.**

Leaders and soldiers need to take a positive approach to maintaining the capability of their unit in SWA. Leaders must foster an attitude in their soldiers of environmental mastery which emphasizes pride in the success of their adaptation to the extraordinary circumstances of SWA. Hiding from the environment is not feasible. Soldiers must be confident that they understand and can deal with the environmental challenges that confront them. We hope the information presented here provides leaders with the knowledge necessary to sustain fighting strength in SWA operations.

ENVIRONMENTAL MEDICAL THREATS IN SWA

1. **HEAT** - SWA is one of the hottest places on earth during the summer months. Both temperature and humidity are high enough to require changes in unit work schedules and rates. Soldiers will need to be protected from the heat and sun.
2. **COLD** - The desert can be dangerously cold in winter with wind-chills well below freezing. Soldiers must be as prepared to keep warm at night as they are to keep cool in the day. Although most consider the SWA theater to be a dry place, areas of the Persian Gulf coast are marshy and can be cold in the winter. Soldiers operating in these conditions need to protect themselves against cold-wet injuries.
3. **DUST, SAND AND WIND** - Dust and sand are omnipresent throughout SWA and are hazardous to soldiers and equipment. Sand in uniforms causes chafing and skin infection. Dust causes eye irritation and infection. Dust and dry air cause asthma attacks. Wind and sun dry and burn the skin, causing discomfort, creating openings for infection, and reducing heat tolerance.
4. **FIELD FEEDING PROBLEMS** - The SWA environment, by itself, does not present unique demands on nutritional requirements or food intake, except increased needs for water, and possibly, salt. The general problems encountered when soldiers eat field rations as a steady diet are magnified in the desert, however. Soldiers do not usually eat enough in a field environment.
5. **OTHER DISEASES & NONBATTLE INJURIES** - Disease and nonbattle injuries account for most casualties in war. Diseases prevalent in SWA can increase risk from other environmental threats. The reduction in mental and physical performance which accompanies dehydration and heat strain increases the likelihood of injury.
6. **OPERATIONAL STRESS** - Physical and mental demands of military operations can have profound effects on the performance of individual soldiers and units. This is particularly true when the stress of combat is intensified by heat, MOPP, and continuous operations.

GENERAL CONCERNS FOR LEADERS

- o Assumptions and habits developed in CONUS, Europe, Korea, or even Vietnam, cannot be relied on in SWA. Your unit's operational success will depend on its ability to cope with the SWA environment. Prepare to learn and adapt quickly. Look, listen and learn from those already there.

- o The adverse effects of the environment, deployment and sustained operations are cumulative and require special command attention to maintain unit effectiveness in the face of these stressful factors.

- o **WATER IS A CRITICAL TACTICAL CONCERN:** water requirements are high and natural supplies are rare. Water is as important as ammunition in your logistics planning.

Water is the primary tool for maintaining individual performance, health and hygiene in the desert heat. Limited availability will affect your unit's operational capability, as well as your ability to prevent illness and disease.

- o SWA temperature extremes and the rapidity of change will be a new experience for most soldiers and leaders. Be prepared by using sources of weather information described in FM 34-81/AFM 105-4, Weather Support for Army Tactical Operations, August 1989.

- o **DO NOT BECOME COMPLACENT:** chronic dehydration is possible without any signs of thirst, and resultant physical performance problems may only be seen under the additional stress of combat operations. A reduction in mental performance is often the first sign of dehydration and heat strain, and individual and unit performance can degrade so slowly that leaders may not recognize the problem in themselves or others. **AS LONG AS ENVIRONMENTAL AND WORK CONDITIONS DON'T CHANGE, YOUR WATER REQUIREMENTS WILL NOT GO DOWN. MAINTAIN ENFORCED DRINKING THROUGHOUT THE PERIOD OF DEPLOYMENT.**

- o Heat injury and illness are preventable in garrison and in training, and controllable during operations. The successful leader will be one who best minimizes the individual and unit performance problems imposed by the environment through informed planning and thorough preparation.

- o The animals and plants of SWA are unfamiliar and many are hazardous. Soldiers should respect the native inhabitants of the environment and protect themselves.

PREPARATION FOR DEPLOYMENT

1. Attain peak physical fitness and heat acclimatization prior to deployment. Maintain adequate levels of physical fitness after deployment with maintenance programs tailored to the environment. Physically fit troops acclimatize to heat more rapidly than those less fit. Units on alert, or identified for future deployment, should immediately optimize their physical training program and state of heat acclimatization (e.g., spend more time exercising in the heat).
2. In terms of physical fitness, troops should not be allowed to physically de-train while enroute (by ship) or once they arrive at their deployment site. The degree of physical activity maintained at the deployment site (i.e., intensity of work plus PT) is the key to maintenance or loss of optimal fitness levels. Physical de-training can produce measurable decrements in fitness within about 2 weeks. If operations are conducted in static positions (e.g., defense), some form of physical training should be initiated within one week.
3. Be sure soldiers pack and bring clothing and personal equipment for cold and wet as well as heat. Blankets, extra socks, scarves or bandannas (for sun as well as dust protection), rain gear, gloves, sweaters, long underwear, overboots, ground cloths, insect netting, solar blankets, sun screen, and air mattresses are all appropriate.
4. Leaders and NCO's must be familiar with the management of work-rest cycles and the critical need for maintaining adequate water consumption. **IT IS DANGEROUS AND INAPPROPRIATE TO TRY TO REDUCE WATER CONSUMPTION.**
5. Set up a buddy system to maintain hygienic discipline and provide first aid; soldiers should review first aid procedures for heat and cold injuries.
6. Follow sound preventive medicine practices. Emphasize the health threat of native food and water. Retrain in field sanitation practice: placement, maintenance and closure of latrines; water purification, storage and handling; sanitary food and ice handling; and insect control and protection.
7. Follow medical guidelines for disease prophylaxis. Assure that soldiers receive appropriate immunization prior to arrival in country. Remember, influenza will be a threat in SWA, too. Some units may be required to begin taking weekly tablets for malaria prevention.
8. Personnel requiring prescription eyeglasses should deploy with two pairs of regular eyeglasses, one pair of sunglasses, and eye inserts for the protective mask.
9. Personnel should deploy with a 90-day supply of personal medications; don't depend on the local economy for non-prescription medicine.

MANAGING ENVIRONMENTAL THREATS

HEAT

The extreme heat of SWA puts soldiers at risk of degraded performance, heat exhaustion and heat stroke. For optimum mental and physical performance, body temperatures must be maintained within narrow limits. Thus, it is important that the body lose the heat it gains during work or from the environment. The amount of heat accumulation in the human body depends upon the amount of physical activity, the level of hydration, the state of personal heat acclimatization, the clothing worn, the load carried, as well as terrain and climatic conditions. Unit leaders must watch their soldiers carefully for signs of distress in the heat and adjust schedules, work rates, rest and water consumption according to conditions.

Normally, several physical and physiological mechanisms (e.g., conduction, convection, evaporation) assure transfer of excess body heat to the environment. But when air temperature is above skin temperature (around 92°F), the evaporation of sweat is the only operative mechanism. Following the loss of sweat, water must be consumed to replace the body's loss of fluids. If the body fluid lost through sweating is not replaced, dehydration will follow. This will hamper heat dissipation and lead to heat illness. When humidity near the skin is high, evaporation of sweat is inhibited and there is a greater risk of heat strain.

Understanding the Problem

1. Heat, wind and dry air combine to produce a high individual water requirement, primarily through loss of body water as sweat. Sweat rates can be high even when the skin looks and feels dry.
2. Dehydration nullifies the benefits of heat acclimatization and physical fitness, increases the susceptibility to heat injury, reduces work capacity (including G-tolerance in pilots), appetite, and alertness. A lack of alertness can indicate early stages of dehydration.
3. Thirst is not a adequate indicator of dehydration. The soldier himself will not sense when he is dehydrated and will fail to replace body water losses, even when drinking water is readily available. The universal experience is that soldiers in the desert exhibit "voluntary dehydration"; that is, they maintain themselves about 2% of bodyweight (1.5 qts.) below their ideal hydration status without any sense of thirst.

Since performance declines significantly when body water contents are more than 2% below ideal levels (as measured by body weight), soldiers must consciously remind themselves, or be reminded, to replace water lost to sweat. It is therefore necessary to make the regular and timely administration of fluids be the responsibility of the unit CO/NCO. This should be done according to the guidelines provided in the appendix.

4. Chronic dehydration increases the incidence of several medical problems: constipation (already an issue in any field situation), piles, kidney stones, and urinary infections. The likelihood of these problems occurring can be reduced by enforcing mandatory drinking schedules.

5. The key to heat strain management is knowledge of the environmental conditions. Make sure you have accurate weather information for your location. Existing Heat Injury prevention guidance is based on Wet Bulb Globe Temperature (WBGT) readings (TB MED 507, FM 21-10, and GTA 8-5-45). It is **approximate** guidance. It was optimized for conditions other than those commonly seen in the desert, and for soldiers who are fully acclimatized, optimally conditioned, hydrated and rested, and not encapsulated in chemical protective clothing.

Leaders at all echelons should use and support the extensive weather forecasting resources described in FM 34-81/AFM 105-4, Weather Support for Army Tactical Operations, August 1989. Helpful hints for accurate measurement of WBGT readings can be found in the appendix to this document.

7. Check the weather daily; day to day and region to region variations in temperature, wind and humidity are substantial. Know what YOUR weather will be.

8. Resting on hot sand will increase heat stress; the more body surface in contact with the sand, the greater the heat stress. Ground or sand in full sun is hot, usually 30-45 degrees hotter than the air, and may reach 150°F when the air temperature is 120°F. Cooler sand is just inches down; a shaded, shallow trench will provide a cool resting spot.

9. One heat casualty is usually followed by others and is a warning that the entire unit may be at immediate risk - this is the WEAK LINK RULE. ASSESS THE STATUS OF THE WHOLE UNIT AT THAT POINT.

10. At the first evidence of heat illness, have the soldiers stop work, get into the shade, and rehydrate. Early intervention is important. Sick soldiers who are not taken care of early become more serious casualties.

11. A soldier who cannot continue work in the heat is a heat casualty, even if unit-level rehydration and rest in the shade leads to recovery.

Minimizing the Problem

1. Attain Required Heat Acclimatization

a. Significant acclimatization can be attained in 4-5 days, but full acclimatization takes 7-14 days with 2-3 hours per day of exercise in the heat. Gradually increase physical activity until full acclimatization is achieved.

Acclimatization requires that progressively more physical activity be performed each day. During the first two days of heat exposure, light activities such as calisthenics and recreation activities (e.g., softball) would be appropriate. By the third day of heat exposure 2-mile unit runs at the pace of the slowest participants are feasible, and leaders should gradually increase the intensity of exercise each day, working up to the normal physical training schedule (adapted for the environment) by the tenth day. ALWAYS ADJUST PHYSICAL ACTIVITY LEVELS TO THE PREVAILING ENVIRONMENTAL CONDITIONS, EVEN DURING ACCLIMATIZATION.

b. Be sure replacement personnel have time to adjust to their new environment even if acclimatization measures have been employed prior to deployment.

c. **Acclimatization does NOT reduce, and may actually increase, water requirements.** Heat acclimatization increases sweating to enhance the evaporative cooling capacity of the body. Increased sweating requires additional water consumption.

d. Soldiers may have a few days of increased salt requirements upon initial deployment because sweat is heavy and salty prior to acclimatization. Complete consumption of rations is essential to provide an adequate salt intake. Salt supplementation is not appropriate unless medically indicated and supervised by medical personnel.

e. The period of acclimatization is the ideal time to train new arrivals to avoid heat injury by learning proper work/rest and water consumption habits.

2. Enforce Water Consumption

a. New arrivals are usually dehydrated and must be provided fresh drinking water upon arrival in country.

b. Establish mandatory drinking schedules which assure that water lost by sweating is replaced. Use the tables provided in the appendix to match the environmental and operational demands to the water requirement.

The body normally absorbs water at the rate of 1.2 to 1.5 qts/hour leading to a theoretical maximum of around 7 gallons in a 24-hour day if drinking is continuous; this is close to the observed maximum. A more reasonable total consumption estimate for a 12 hour work day in the summer is 3-4 gallons. Since desert sweat rates during work in the heat can easily reach 1.5 qts/hr (more in MOPP), it is obvious that even the most rigorously enforced drinking schedule will fail to match water losses, unless the work schedule and other factors affecting heat gain/sweat loss are also carefully managed.

c. Assure adequate hydration of all soldiers before any period of exercise or work, particularly after a long rest period.

d. Plan operations to provide water resupply points and supply backups at a maximum interval of every three hours. One-hour intervals are desirable.

e. SECURE ALL WATER SOURCES; TREAT WATER AND WATER SUPPLIES AS YOU WOULD ANY CRITICAL TACTICAL RESOURCE. BE SURE OF YOUR WATER SUPPLY, IT IS THE MOST BASIC NEED IN THE DESERT.

f. All unit leaders must understand the critical importance of maintaining hydration status. Almost any contingency of military operations will act to interfere with the maintenance of hydration.

g. Unit leaders should insist on urine monitoring to increase awareness of hydration and learn how to judge hydration from urine color.

If urine is more colored than diluted lemonade or the last urination cannot be remembered, there probably is insufficient water intake. Collect urine samples in field expedient containers and spot check the color as a guide to insuring proper hydration. Soldiers should inspect their own urine, and use the buddy system to watch for signs of dehydration in others.

h. Minimize voluntary dehydration by removing barriers to drinking. Make palatable (flavored, cool) water accessible in a comfortable place, and provide enough time to drink and eat.

Provide cool water (60-70°F) by shading, insulating, and camouflaging water buffaloes or by using small mobile chillers. Desert water bags will keep water as cool as the prevailing wet bulb temperature, at a cost of part of the bag's water contents lost to the process of evaporative cooling.

i. Carbohydrate/electrolyte beverages (e.g., "gatorade") are not required, and if used should not be the only source of water. They are too concentrated to be used alone and many athletes prefer to dilute these 1:1 with water.

j. Diseases, especially diarrheal diseases, will complicate and often prevent maintenance of proper hydration (see **OTHER DISEASES & INJURIES** section below).

k. Water is the key to your health and survival. Drink before you become thirsty and drink often. When you become thirsty you will be about a "quart-and-a-half low".

l. Carry as much water as possible when separated from approved sources of drinking water. Man can live longer without food than without water.

m. Drink before you work; carry water in your belly, don't "save" it in your canteen. Learn, if you can, to drink a quart or more of water at one time and drink frequently thereafter to replace sweat losses.

n. Assure soldiers always have at least one full canteen in reserve; know when and where water resupply will be available.

o. Thirst does not appear until dehydration is well advanced. Thirsty soldiers are significantly dehydrated and will require a minimum of 1.5 quarts of water to begin the restoration of their water reserves. If soldiers are issued bottled water, remember that 1 liter is approximately equal to 1 quart.

p. Additional useful information can be found in FM 10-52-1, Commander's Guidebook for Water Usage in Desert Operations, May 1983.

3. Use Clothing and Cover

a. Uniforms should be worn to protect against sun and wind. Wear the uniform loosely. Use hats and head cloths, goggles and sunscreen.

Heat strain will actually be reduced by shielding the body from some of the radiant heat from the sun and hot sand. Wearing the full Desert Battle Dress Uniform (DBDU) reduces sweat losses of water by reducing heat gain, as well as reducing evaporation.

b. Sunglasses should be used to reduce glare; they must have lenses with adequate UV protection.

c. A deployment to SWA is not the time to work on your tan.

Sunburn can increase the risk of becoming a heat casualty. Severe sunburn cases are casualties even if not suffering from heat illness. Use sun screen and stay in the shade as much as possible. Do not lie down in the sun.

d. Solid objects, like tools and vehicles, in the sun will be very hot and will cause burns if touched; keep them out of the direct sun where possible and use gloves to protect hands from burns. Don't rest against the side of a vehicle that is in the sun.

e. Swelling of the hands and feet is common in extreme heat; finger rings are dangerous in the heat. Wear rings on the dog tag chain (tape them together to prevent noise).

f. In a hot environment, soldiers sweat much more when in MOPP IV compared to DBDU.

Compared to the DBDU, the relative impermeability of the Battle Dress Overgarment (BDO) reduces evaporative cooling capacity. Wearing underwear and the complete DBDU, with the sleeves rolled down, under the chemical protective overgarment, may provide additional protection against chemical poisoning. However, this will also substantially increase the likelihood of heat strain casualties.

g. Provide shade whenever possible; use canvas, ponchos, or parachutes, but allow for free air circulation.

h. Change socks if they become soaked with sweat.

Prolonged wear of wet socks can lead to foot injury (e.g., increased risk of blisters, "paddy-foot"). Although dry desert air promotes evaporation of water from exposed clothing and may actually promote cooling, sweat tends to accumulate in the boot.

4. Manipulate Physical Activity and Work Rates

a. Body temperature can rise very rapidly because of the combination of excessive climatic heat and sustained physical activity. Even while sweating and drinking, the heat lost to the air may not equal the accumulation of body heat. To prevent this continuous rise in body temperature, it is mandatory to minimize the heat production. Providing adequate and recurrent rest periods, or working at a slower pace in shaded, cooler places are effective countermeasures.

b. Whenever possible, plan to perform heavy work in the early morning or evening hours to avoid the heat of the day.

c. Maintenance-level PT programs should be conducted in the evening or at night when WBGT readings for your location do not exceed accepted guidelines.

WBGT guidelines do not accurately forecast injury/illness rates under conditions of lower temperatures and high humidity such as may be experienced in the early morning hours in the desert; humidity levels over 75% contribute a substantial risk of heat injury.

d. Be prepared to adjust work schedules and amounts to compensate for weather changes.

e. Declining mental performance may not be noticed by the soldier; plan for shorter work shifts, double checking of work products, and slower work pace. Enforce drinking, eating, and rest schedules.

COLD

The desert can be dangerously cold. The dry air, wind and clear sky can combine to produce bone-chilling discomfort and even injury. Just as in the heat, the ability of the body to maintain body temperature within a narrow range is important in the cold. Loss of body heat to the environment can lead to cold injury; a general lowering of body temperature results in hypothermia and local freezing of body tissues can lead to frostbite. Hypothermia is the major threat from cold in the desert, but frostbite can occur. Soldiers must have enough clothing and shelter to keep warm. They will be tempted to leave behind clothing and equipment that seems unnecessary (and burdensome) during the heat of the day. Cold-wet injuries (immersion foot, trench foot) may be a problem for dismounted troops operating in the coastal marshes of the Persian Gulf during the winter.

Understanding the Problem

1. Check the weather; know what conditions you will be confronting. The temperature during the day is no guide to nighttime temperatures; 90°F days can turn to 30°F nights.

2. Anticipate an increased risk of cold-wet injuries if a proposed operation includes lowland or marshes. Prolonged exposure of the feet in cold water causes immersion foot injury, which is completely disabling.

3. Air temperature, windspeed, solar radiation and humidity are all determinants of environmental cold stress.

The effect of wind (i.e., wind-chill) on the perception of cold is well known. Wind-chill charts (FM 21-10) allow estimation of the combined cooling power of air temperature and wind speed compared to effects of an equally cooling still-air temperature. Wind-chill only estimates the danger to exposed flesh and windproof clothes can reduce the danger to that presented by the still-air temperature alone. In contrast to heat stress, wind-chill effects pose a greater danger to immobile soldiers than exercising or working soldiers, unless the uniform is wetted by sweat.

Minimizing the Problem

1. **Use Clothing and Cover**

- a. Ensure soldiers are adequately equipped for cold; extra socks and clothing are essential.

Soldiers should have enough dry socks for 2-3 changes per day and need a continuous supply. Provide 2 or 3 opportunities each day to completely dry and warm the feet and change socks. Instruct NCO's in how to care for soldier's feet.

- b. Stay dry; wet clothing has less insulating value. Ensure soldiers regularly change their clothes, especially their socks, when wet.

Immersion foot can be prevented by careful attention to foot care. Work in the cold can lead to overheating and soaking of the clothing through sweat accumulation. Wet clothing allows the effects of wind-chill to increase risk of hypothermia and other cold injury.

- c. Wear clothing loose and layered; both enhance the insulating value of clothing. Layers also allow easy adjustment of clothing for comfort.

- d. Avoid the direct effects of the wind.

Don't stand still in the wind - keep moving or seek shelter to cancel the extra cooling power of the wind. Remember that extra clothing protection will be required when riding in an open vehicle. Use dry, windproof clothing and natural or artificial barriers as wind breaks. Minimize exposed skin areas.

- e. Erect heated warming-tents, particularly at remote sites. Avoid carbon monoxide poisoning; assure adequate ventilation when using open flames in enclosed spaces.

f. Metal Foil Survival Blankets (NSN 7210-00-935-6667) are very useful for staying warm at night and add little weight to the soldier's load. They are not effective if clothing is wet, however.

g. Covering your head will keep you warmer.

h. Insulate yourself from the ground, as well as the air, if it is cold.

Sometimes in the desert large rocks or buildings will retain the daytime heat and can be a source of warmth (keep in mind that other desert dwellers may have the same idea ---- be very alert for snakes and scorpions).

i. Clean clothes are more insulating than dirty ones.

j. Use gloves and protective clothing when handling solvents and fuels.

These substances, even if not frozen, can be cold enough to cause a cold injury. Be careful not to get these substances on exposed skin. The evaporation of solvents, and water, produces additional cooling power.

k. Where possible, provide elevated dry flooring for tentage.

2. Maintain Adequate Nutrition & Hydration

a. The dry and windy conditions of the desert, even when it's cold, keep water requirements high. Dehydration increases the risk of cold injury and contributes to discomfort in the cold.

b. Provide warm food and drinks at night, when possible; this provides a boost to morale as well as warmth.

c. A meal and adequate water just before sleep will help you keep warm.

d. Adequate drinking and food intake will reduce the susceptibility to cold-wet injury.

4. Manipulate Physical Activity and Work Rates

a. Plan for shortened periods of post or sentry duty to allow soldiers an opportunity to get warm.

b. If you are shivering, do something to help warm yourself. Put on more clothing and use your large muscles to generate internal heat (pushups, calisthenics, isometric contractions, etc.) and get help.

c. Use the buddy system; watch each other closely to prevent cold injury. In the cold, no one should go unsupervised for long periods of time.

DUST, SAND AND WIND

Natural sandstorms and blowing dust generated by vehicles and helicopters are a hazard to skin, eyes and respiratory system. Cleaning dust and sand from the body and clothes is limited by the restricted water supply available in the desert. The desert wind and sun combine to dry and burn the skin, causing reduced heat tolerance, discomfort and routes for infection.

Understanding the Problem

1. Dust and sand cause health problems, particularly to skin and eyes.
Soldiers must be kept alert to take care of problems early to avoid infection. Dry air, dust and wind will dry out the mucous tissues lining the nose and throat, and can cause nosebleeds. Cracked, chapped lips can make eating difficult and cause problems in communication.
2. Technical work spaces which are protected from dust and sand will likely be very hot. Work/rest cycles and enforced water consumption will be required.
3. Wind will turn tent pegs and loose objects into flying missiles (which may be invisible in blowing sand). These can inflict serious injury; any potential missile should be secured.

Minimizing the Problem

1. Units must ensure adequate equipment for soldiers to protect themselves from dust, sand, and wind.
2. Units should provide each soldier with 2.7 gallons of water daily (TRADOC Pam 525-11) for personal hygiene; at a minimum have each soldier take a daily "sponge bath".
In addition to promoting good hygiene, this daily cleansing will facilitate optimal sweating and evaporative cooling.
3. Sleeping in tents in the wind can be noisy; plan routes for air circulation to minimize "flapping".

4. Contact lenses are very difficult to manage in the dry dusty environment of the desert and **SHOULD NOT BE USED EXCEPT BY MILITARY PERSONNEL OPERATING IN AIR CONDITIONED ENVIRONMENTS, UNDER COMMAND GUIDANCE.**

Great care must be taken to assure adequate cleanliness of the washing and rinsing solutions; contact-wearing soldiers who develop eye irritation should discontinue wearing them immediately and be examined by medical personnel for corneal infection or abrasion.

5. Drying of mucous membranes can be reduced by breathing through a wet face cloth, snuffing small amounts of water into nostrils (native water is not safe for this purpose), or coating the nostrils with a small amount of vaseline. Lips could be protected with "chapstick".

6. Scarves and bandannas can be used to protect the head and face in the field.

7. Moving vehicles create their own sandstorms and soldiers traveling in open vehicles should always wear protection.

8. Goggles (sun, wind and dust) should always be worn for eye protection when exposed to winds, dust and sand.

9. The face should be washed as often as possible. The eyelids should be cleaned daily. Artificial tears (e.g.,) may be appropriate for some individuals.

10. Body areas that collect dust and sand are susceptible to chafing, abrasion and infection.

Likely areas for problems are ears, armpits, groin, elbows, knees, and feet. Clean these areas as often as possible using field expedient means (wet cloth, commercial wet-wipes, etc.).

FIELD FEEDING PROBLEMS

Food is the basis for sustaining soldier strength and morale in any military setting. Units must assure adequate quality and quantity of food for their soldiers. SWA presents some special problems in the storage, preparation and consumption of food.

Understanding the Problem

1. Soldiers may reduce voluntary food intake by 20-40% when deployed to a field feeding situation. If this problem is not prevented, body weight loss can quickly reach a level where it impairs physical and mental performance.

2. Hot environments, by themselves, do not have unique effects on nutritional requirements or food intake (except for water and, perhaps, salt; topics covered elsewhere), but worsen the general problems encountered when soldiers begin to eat field rations.

3. Food requirements are not reduced in the heat. It is a common misconception that the amount of food or energy needed decreases during hot weather. Although the desire to eat goes down, the amount of calories required actually increases slightly in hot weather. This will be a bigger problem during the first few days, and will gradually go away within the first two weeks. It is more serious in troops not heat acclimatized.

Minimizing the Problem

1. The problem of reduced food intake in the field can be minimized by using a few simple techniques. Important points for maintaining soldier food intake in a hot field environment include:

a. Watch what the soldiers are eating.

Small unit leaders must watch to see what their soldiers are eating or failing to eat. Often, no one knows a food problem exists because they aren't actively looking for it. It is hard to fix a problem which no one is sure exists.

b. Do not assume that a meal issued is a meal fully consumed.

Specific personnel should constantly monitor food serving lines, etc., to see which foods and food items are being eaten, how much of each one is being eaten, and also which things are not being eaten. Combat rations (MRE's) present a real challenge to monitoring by leaders.

c. Soldiers must be taught that food and water are tactical weapons.

Soldiers must be taught the importance of eating and drinking to their health and performance, whether they like what is offered or not, and whether hungry or thirsty or not. Well disciplined and trained troops generally will police their own food consumption patterns if they are convinced that eating enough is important.

d. View all weight losses as negative.

Do not permit field deployment to be used as a convenient way of going on a diet. Even if soldiers are overweight, the lower food intake will have a negative impact on performance. Weight losses over 2% of bodyweight can negatively influence performance, so don't let soldiers operate under the misconception they can lose weight, and it is no big deal.

e. Maintain hydration status.

Even mild (2% of bodyweight) dehydration will reduce the desire to eat.

f. Use cold, preferably flavored fluids at meal times.

Lack of fluids or only having access to fluids they do not like, will have a dramatic negative impact on the amount of food eaten at a meal.

g. Control use of pogeys, bait and other non-issue foods.

Do not allow pogeys, bait, carbohydrate beverages (i.e. gatorade-like drinks, kool-aids, soda, etc.) to be used as substitutes for meals or rations. These items can be useful supplemental additions to the ration being given. But, they must only be used as supplements to provide calories; they cannot be considered as a replacement for nutritionally complete foods. Additionally, it is important that soldiers do not eat so much of these extraneous foods, that they are full when it comes time to eat their rations. Carbonated beverages can reduce fluid and food intake by imparting a sense of fullness.

h. Serve at least 1 hot meal per day.

This is probably the simplest, most effective single thing one can do to help maintain voluntary food intake. It doesn't matter if the 1 hot meal is a T-ration, B-ration or A-ration; all three are equally effective. If 2 hot meals are given, A-rations are superior to T's or B's.

i. Ensure that each meal is prepared as well as it can be.

If a meal or single food is ill-prepared once, soldiers will always perceive that food as bad, regardless of how well it is prepared at subsequent meals. Thus, consumption of a good, generally well-accepted food item will be poor if it is poorly prepared only one time, and soldier acceptance of it will never recover.

j. Use regularly scheduled meal times if possible.

Food intake is almost always higher at anticipated meals compared to impromptu meals. Have as many meals as possible at preset times that the soldiers know about. This applies to snack breaks as well as major meals. Very late arrival of scheduled hot meals is usually bad for morale.

k. Use a variety of foods and food items.

Monotony will be the biggest problem which develops over time. Almost anything different will help maintain food intake, especially if it does not come in a green can or brown retort pouch.

l. **Eat all the rations served**; they may be boring, be unappetizing and not at all what you would freely choose, but they contain ALL the nutrients and salt which are essential for your health and fitness in the desert environment.

3 MRE's per day contain all the salt and nutrients your body needs to survive in the desert. Three MRE packages eaten per day provide approximately 3900 calories, 147 grams protein, 483 grams carbohydrate; 156 grams fat and 300 milligrams cholesterol. The percent of calories from protein is 15%, fat - 36%, carbohydrates - 49%. To reduce the fat in the MRE would require reducing the grams of protein, which would, in turn, make the portions of meat, cheese and peanut butter smaller.

m. Assume all native food is contaminated and might cause gastrointestinal illness.

If local foodstuffs are to be used to supplement rations, they must be prepared in a facility with the resources to guarantee wholesomeness and disinfection.

n. Keep stored food as cool as possible; allow 6-12 inches of air circulation space between coverings and food containers.

OTHER DISEASES & INJURIES

Diseases resulting from exposure to indigenous disease causing and carrying organisms can increase the impact of heat, cold and other environmental and operational threats. Diseases which adversely impact hydration, such as those which include nausea, vomiting, and diarrhea among their symptoms, can act to dramatically increase risk of heat (and cold) illness or injury. Infectious diseases can result in a fever; this may make it difficult to diagnose heat illness. Occurrence of heat illness in soldiers suffering from other disease processes may complicate recovery from both.

Many of the native animals and plants in SWA are hazardous. In addition to injuries received as a result of bites, these natural inhabitants of the desert can be a source of infectious disease.

Understanding the Problem

1. Diarrheal and Insect-borne Disease

a. The most common and significant infectious diseases in SWA include diarrheal disease and insect-borne febrile (i.e., fever causing) illnesses - BOTH TYPES OF DISEASE ARE PREVENTABLE.

Most diarrheal diseases result from ingestion of water or food contaminated with feces. Flies, mosquitoes and other insects carry fever-causing illnesses such as malaria, sand fly fever, dengue, typhus and tick fevers.

b. There are no safe natural water sources in the desert.

Natural standing water is usually infectious or too brackish to be safe for consumption. Units and soldiers must always know where and how to get safe drinking water.

c. The food in native markets should be considered hazardous.

Local food should be avoided unless approved for consumption by U.S. Military officials.

d. Assume raw ice and native water are contaminated and will cause vomiting and diarrhea.

Ice has been a major source of illness in all prior conflicts. Raw ice cannot be properly disinfected and probably is contaminated. Only use ice from approved sources.

e. Water supplies with insufficient chlorine residuals (<5 ppm), native water supplies and native food and drink, as well as ice from all sources, are common sources of infective organisms.

f. Native water used for washing or bathing carries a risk of infection even if you don't drink it.

g. Brackish (i.e., salty) water can act like sea water and INCREASE thirst; it also dehydrates the soldier faster than if no water was drunk.

Brackish water is common even from public water supplies in SWA. Iodine tablets only kill germs, they do not reduce brackishness.

- h. Commercial flavorings prevent water disinfectants from working.

Adding flavorings to the canteen is not recommended; canteen water may be required for emergency hygiene (e.g., eye wash) or wound cleaning.

Flavorings are best added to water served with meals. Flavorings can be added 30 minutes after disinfection; this assures that the water is initially safe to drink. Once the flavoring is added, the contents of the container become inherently dangerous unless drunk quickly, prior to recontamination. Water containers must have all traces of commercial flavoring rinsed out before disinfectants are next used.

2. Injuries from Plants and Animals

- a. Plant and cactus spines cause blistering and infection.

Many plants and shrubs have a toxic resin which will cause blisters or spines which will cause infection; milky sap should be considered poisonous; all red beans are poisonous; smoke from burning oleander shrubs is poisonous.

- b. Poisonous snakes and scorpions are found throughout the SWA Theater of Operations.

- c. Snakes, spiders, and scorpions inhabit bunkers, sandbags and old buildings. Remember them as an additional hazard during operations or when seeking shelter.

- d. Coastal waters of the Persian Gulf contain hazardous marine animals including sea snakes, poisonous jellyfish and sea urchins.

Minimizing the Problem

- 1. Both diarrheal and insect-borne diseases are prevented through a strategy which breaks the chain of transmission from infected sources to susceptible soldiers. Personal and unit measures can be effectively applied.

Successful application of those methods which interrupt the chain of transmission of "germs" requires constant care and vigilance on the part of soldiers and leaders. Follow the guidance contained in FM 21-10, Field Hygiene and Sanitation, November 1988.

- a. Careful storage, handling and purification/preparation of water and food are the keys to prevention of diarrheal disease.

- (1) *All food, water, ice and other beverages should be procured from U.S. Military approved sources and routinely inspected.*

- (2) *Well cooked foods that are "steaming hot" when eaten are generally safe, as are peeled fruits and vegetables.*
- (3) *Local dairy products and raw leafy vegetables (e.g., lettuce, spinach) are generally unsafe for consumption in SWA.*
- (4) *If any uncertainty exists concerning the quality of drinking water, soldiers should disinfect their supplies using approved field-expedient methods (e.g., hypochlorite for lister bags, iodine tablets for canteens, boiling).*

b. Hand washing facilities should be established at both latrines and mess "halls". **Assure that all soldiers wash their hands after using latrine and before eating.** This is a highly effective way of breaking the chain of disease transmission.

c. Bathing, showering and recreational swimming should not be allowed except in U.S. Military inspected and approved facilities.

Any unapproved water source should be considered contaminated with disease causing organisms. Small amounts of fecal materiel from infected individuals can contaminate a very large reservoir.

d. Dispose of human wastes and garbage as specified in FM 21-10. Sanitary disposal is important in preventing spread of disease from infected individuals, insects and animals to soldiers. Construction and maintenance of clean, sanitary latrines is essential.

e. In the event of an outbreak of diarrhea or vomiting, an oral rehydration solution which will counteract the loss of body fluids can be prepared and consumed if medical attention is not readily available:

Add 40 grams of table sugar (8 individual 5 gram packages) and 6 grams of table salt (1 level dinner teaspoon) to 1 qt of water. Continue therapy until diarrhea or vomiting ceases or until medical attention is available. These quantities can be scaled up to make 5 gallons (20 quarts) at a time (1-3/4 pounds of sugar to 20 teaspoons of salt).

- f. Assure soldiers have adequate insect repellent and netting and know how to use both.

Soldiers should apply insect repellent to all exposed areas of skin, as well as several inches beyond openings in clothing (e.g., collars and sleeves). Pay special attention to the face and ears (but keep out of eyes); these areas are preferred feeding sites of insects due to their greater blood supply. Use the new sustained action repellent if available (DEET repellent lotion, NSN 6840-01-284-3982). Remember to apply before going to sleep. Soldiers should have their DBDU's treated with the insect repellent Permethrin (NSN 6840-01-278-1336), preferably before they deploy. Where sandflies and mosquitoes are prevalent, insect netting should also be treated.

- g. Assure proper wear of the uniform; blouse the trousers and roll down sleeves when insects are prevalent.

The amount of discomfort and heat gain from rolling down the sleeves of the DBDU is not as significant as the protection from insect bites the uniform provides.

- h. Unit areas should be sprayed with insecticide only when other preventive measures have failed.

2. Plants and Animals

- a. DO NOT HANDLE UNFAMILIAR PLANTS OR SNAKES, SCORPIONS AND OTHER ANIMALS.

- b. Avoid problems with native vegetation by keeping the amount of exposed skin to a minimum. Do not put unfamiliar vegetation in your mouth.

- c. Manage refuse and waste disposal to reduce attracting animals and insects. Food and garbage attract animals; don't sleep where you eat; keep refuse areas away from camp.

- d. Survey unit areas for potential animal hazards.

- e. Rabies is present among animals in SWA; do not take any chances with any animal. DO NOT ADOPT PETS.

- f. Shake out boots, clothing and bedding before using.

OPERATIONAL STRESS

1. The physical signs and symptoms of heat-related illness or combat stress are often preceded by changes in military performance that are ignored. This is particularly true when the stress of combat is intensified by heat, MOPP, and sustained operations.
2. Leaders should not dismiss soldier complaints, discomfort, confusion, disorientation and performance degradation as inevitable by-products of the combat environment; mission success depends on the integrated performance of all individual members. Unit leaders should prepare themselves to recognize the behavioral signs of environmental and operational stress, and implement corrective actions.

Understanding the Problem

1. Military Performance in the Heat.

- a. All soldiers are susceptible to heat stress. Dehydrated, sleep deprived, or undernourished soldiers are most vulnerable.

Heat stress affects performance in many different kinds of jobs. Jobs which require physical exertion cause physiological, and mental performance to deteriorate rapidly. However, mental performance of soldiers working at sedentary tasks also deteriorates sharply over time in the heat.

- b. Performance in the following jobs is most likely to be affected by heat stress:

- (1) monotonous, repetitive, or boring tasks;
- (2) tasks which require attention to detail, concentration, and short-term memory (e.g., calculations, radio authentication, map plotting, coding messages, repeating communications, etc.);
- (3) tasks which are not self-paced (i.e., any task that must be done quickly or according to a fixed schedule);
- (4) tasks which require arm-hand steadiness (e.g., aiming and shooting a weapon);
- (5) tasks where confusion, misinformation, and disorientation are common (e.g., command, control, communications, and intelligence positions).

c. Military performance is affected by heat stress in a variety of ways.

Reaction times and decision times are longer. Routine tasks are done more slowly. Errors of omission are more common (e.g., leaving out a critical word in a message or missing a signal). Performance of tasks which require vigilance (e.g., watching radarscopes, sentry duty) may degrade slightly after 30 minutes, and certainly after 2-3 hours. Mechanical mistakes are more common (e.g., reading from the wrong column on a code sheet, or transposing digits in a map coordinate). Rested, well-trained soldiers working on sedentary tasks should be able to work normally in the heat for up to four hours, after that intellectual performance will steadily and progressively deteriorate. For more physical work, performance will deteriorate as physical exertion increases, even in the first 4 hours of duty.

2. Military Performance in Chemical Protective Clothing and Equipment.

a. The wear of chemical protective clothing and equipment will increase the soldier's risk of heat strain.

Guidelines (like those presented above) for reducing heat strain should be followed whenever Mission Oriented Protective Posture (MOPP) is assumed.

b. MOPP IV reduces the individual soldier's ability to recognize and communicate efficiently and may require dramatic changes in personal habits.

Combat often requires that soldiers change their habits (e.g., caffeine/nicotine use, nutrition, personal hygiene, etc.); MOPP may require even more extreme changes in personal habits. These changes can intensify the feelings of isolation and confusion that are common on the battlefield and increase the soldier's vulnerability to combat stress. Leaders can prepare their soldiers to fight effectively in MOPP by engaging in realistic training that builds confidence and cohesion.

c. All soldiers can expect deficits in performance due to the awkwardness of Chemical Protective Clothing and Equipment.

Several factors may increase the probability that soldiers will experience heat-strain or combat-stress while in MOPP. Inexperienced soldiers unfamiliar with MOPP or those who are new to the unit are more likely to be frustrated. Soldiers who work shifts of indefinite length (who do not know when they will get relief from MOPP) are also more susceptible. Although still requiring additional research for verification, at least one study has indicated that women may experience performance decrements in MOPP IV sooner than men.

d. Soldiers who have trained often and realistically in MOPP should be able to compensate for the constraints it places on communication, vision, and movement.

Certain jobs are more likely to be affected than others; e.g., tasks that require clear vision, precise hearing, fine motor skills, social and emotional support, or communication by facial expression, gestures, and inflections in voice.

3. Military Performance during Sustained or Continuous Operations.

a. Sustained or continuous operations often require soldiers to stay awake for extended periods of time.

Sleep in these conditions is often brief, intermittent, and not adequate to restore alertness. MOPP IV decreases sensory awareness making it harder for soldiers to stay awake. All soldiers are affected by sleep loss. Sleep loss also increases the risk of heat strain; the body has more difficulty in maintaining a regulated temperature. Soldiers who must work at night and sleep in the day are most likely to have difficulty getting to sleep and staying asleep. Dehydrated or undernourished soldiers will find it more difficult to concentrate and to stay awake. Soldiers' perceived need for sleep will increase between the hours of 1500 to 1800 and especially from 0200 to 0600 when the body temperature is at its lowest point of the day.

b. Sleep loss affects performance in most jobs.

The ability to make decisions (and to make them quickly), concentrate, memorize short messages, or calculate mathematical problems are the kinds of skills affected first. Thus, commanders at every level, their immediate staff, and all command and control personnel are most vulnerable. Monotonous, repetitive, or boring tasks will increase the perceived need for sleep, especially when the soldier is in MOPP IV.

Minimizing the Problem

1. Military Performance in the Heat.

a. Regular quality checks and specific feedback on performance should be SOP.

Many errors can be detected and corrected before they become life-threatening, if SOP for double-checking coding, communications, map coordinates, etc. are enforced.

b. Soldiers should work 4-hour shifts (with appropriate rest-breaks during the shift). Jobs and soldiers that are most likely to be affected should be switched during shifts.

c. Soldiers should be allowed to do tasks more slowly than normal to maintain accuracy whenever possible.

d. Drinking, eating, and sleeping discipline should be rigidly enforced by commanders at all levels.

2. Military Performance in MOPP.

a. Overtrain visual tasks (especially marksmanship), manual dexterity tasks, and communication tasks while in MOPP.

b. Mark chemical protective overgarments, masks, and hoods so that name, rank, and duty position can be recognized easily. Encourage "small talk" while in MOPP IV.

c. Enforce prohibitions (AR 40-63) against soldiers wearing contact lenses in chemical environments; they only intensify vision problems in the chemical protective mask.

This prohibition does not apply to aircrew members fitted for contact lenses for special purpose wear with the M-43 aircrew chemical protective mask.

d. Enforce MOPP discipline; wear the lowest level required by the threat.

3. Military Performance during Sustained or Continuous Operations.

a. Enforce work/rest schedules, drinking/eating discipline, and sleep discipline, especially among leaders and commanders.

b. Four to six hours of continuous sleep is optimal, but some sleep is better than none.

Sleep periods should be scheduled for 0200 to 0600 hours whenever possible. Soldiers should be encouraged to take "power naps" (e.g., 10 min. to 1 hr.) whenever they safely can.

c. Use the buddy system to check for signs of stress and fatigue; make sure your buddy eats, drinks and sleeps adequately. Pair experienced soldiers with inexperienced buddies.

d. Soldiers who must sleep during the day should have their sleeping areas located away from high traffic areas where other soldiers must work and live.

When this is not possible, leaders must enforce quiet hours and promote common courtesy by non-sleepers towards sleepers, especially during the day.

e. Jobs and soldiers most likely to be affected by sleep loss should be systematically rotated.

Critical jobs should be shared and SOPs for double-checking work should be enforced. Whenever possible work should be done more slowly than normal in order to maintain accuracy.

f. Spot checks should be SOP. They reduce feelings of isolation, verify the accuracy of soldiers' work, and break the monotony, especially when units are in MOPP IV.

g. Prepare soldiers to fight effectively; engage in realistic training that builds confidence and cohesion. Training in MOPP is especially important.

FIRST AID/BUDDY AID

HEAT ILLNESS (GENERAL)

1. Watch your buddy for symptoms or signs of overheating: inability to remain at work, red or flushed face, confusion or disorientation, fainting or collapse. It is always better to take care of a problem early. When in doubt, act.
2. Immediately get heat-stricken buddies into shade, remove any heavy clothing and, if they are alert, start them drinking water. They will probably need at least 3 quarts. The water should be cool but not cold.
3. If enough water is available, sprinkle water on the skin and T-shirt for cooling. Fan the casualty. Even non-potable water will do in this circumstance, as long as you do not get any in the casualty's eyes, mouth or open wounds.
4. If unconscious or confused, the casualty will need evacuation for further evaluation and care. Call for medevac NOW.
5. If confused and very hot, the soldier probably has heat stroke and should be given the highest priority for medical evacuation. If ice is not available, immersion in cool water is the quickest way of reducing body temperature. A field expedient immersion device can be built from tent canvas mounted in a frame off the ground. The water can then evaporate from the canvas and help to cool the bath. If an above-ground frame can not be constructed, a shallow pit lined with canvas can be used.

HEAT CRAMPS

1. Heat cramps may be a problem encountered in individuals working hard in the heat. Stricken individuals develop painful cramps in major muscles in the abdomen and limbs. The symptoms are probably associated with dehydration and/or inadequate salt intake.
2. Affected soldiers need shade and rehydration. Massage sometimes helps the cramps while rehydration is being done.
3. In heat cramps, rehydration should be done with liquids that contain some added salt or electrolytes. At least 3 quarts of fluid will be needed. Give slowly, no more than 1.5 quarts per hour.
4. Although administration of dilute oral salt solutions can be effective in many cases, immediate evacuation may be appropriate if unit resources cannot manage the problem. Faster relief can be obtained when medical personnel give the fluids by vein.

HYPOTHERMIA

1. Watch your buddy. Continuous shivering means the body is losing heat at a rapid rate. You need to provide help NOW. Provide more cover and warmth.
2. Someone who is cold and confused needs to be evacuated. Provide more cover and warmth. If the person is not shivering, active warming is needed. Confused or delirious patients should not be given anything to eat or drink.
3. Someone who is cold and unconscious needs evacuation, even if there are no signs of life. Treat the individual gently and keep the individual from losing more heat. Do not start CPR except under the supervision of a medic.

SNAKE BITE

1. Get the victim away from the snake. Keep victim calm and quiet. Do not handle the snake or put yourself at risk of being bitten. Identify the snake if possible. If it has been killed, keep it.
2. Immobilize the site of the bite. If possible, keep the site of the bite below the level of the heart.
3. Do not give the victim anything to eat or drink.
4. If the bite is on one of the upper limbs, remove any rings or jewelry from that side.
5. Arrange immediate evacuation. If there is no evidence of venom, keep the victim quiet and under observation.
6. If there is evidence of venom (swelling, spreading pain, bruising, symptoms remote from the bite area), and LESS than 30 minutes have passed since the bite, place a band about 4 inches above the bite. Tighten it just to the point that you can only get one finger beneath it. Do not remove the band but, if swelling develops, be prepared to adjust it so that it gets no tighter.
7. An ice pack can be used intermittently to reduce pain. DO NOT pack a limb in ice or immerse it in ice water.

SCORPION STINGS

1. Ice packs can be used to reduce local pain and swelling.
2. Not all scorpions are poisonous, but if there is evidence of venom (swelling, spreading pain, bruising, symptoms remote from the bite area), medical evaluation is required. Arrange immediate evacuation and observe the victim while evacuation is pending.
3. Effects of scorpion stings can be delayed for hours. Keep the victim under observation for 24 hours.
4. Try to identify the scorpion. If killed, keep it in a secure container.

ACUTE GASTROINTESTINAL ILLNESS

1. Maintain hydration by small frequent doses of oral rehydration fluid; a field expedient version is 8 packets of sugar and one level teaspoon (1-1/2 MRE salt packet) in one quart of water. Fluids should be given slowly and in amounts that minimize vomiting. It is possible to get some fluid retained orally even in the face of severe vomiting.
2. Remember, one case of vomiting and diarrhea means more are likely to be on the way.
3. Medical evaluation is appropriate in all cases.
4. Priority evacuation is appropriate if fever, abdominal pain, rash or bloody diarrhea develop.
5. Antidiarrheal medicines are not appropriate first aid treatment.

DESERT SURVIVAL TECHNIQUES

1. If you are stranded in the desert, survival IS possible. The following ideas are not a substitute for desert survival training, but can provide guidance in an emergency:
2. Never travel without water, matches and some means of navigation and signalling.
3. Travelling on foot in the desert is best done at night.
4. During the day, conserve water by resting in the shade, out of the wind.
5. A man can walk 15 to 20 miles across level desert terrain in a night, but he must know the direction in which to go.
6. Walking at night and resting in the day will require, at a minimum, about 1 gallon of water.
7. Eat food only when there is sufficient drinking water available.

KEY POINTS AND REMINDERS

- o THE KEY TO SUSTAINING HEALTH AND PERFORMANCE IN THE DESERT IS AVOID DEHYDRATION. TRAIN TO DRINK BY SCHEDULE OR COMMAND. DO NOT DEPEND ON THIRST.
- o ADAPTATION TO THE DESERT DOES NOT REDUCE WATER REQUIREMENTS. THERE IS NO WAY TO TRAIN TO REDUCE WATER CONSUMPTION.
- o YOUR SUPPLY OF DRINKING WATER IS AS IMPORTANT AS YOUR AMMUNITION SUPPLY, AND MORE IMPORTANT THAN YOUR SUPPLY OF FOOD.
- o CHECK THE WEATHER DAILY. DAY TO DAY AND REGION TO REGION VARIATION IN TEMPERATURE, WIND AND HUMIDITY ARE SUBSTANTIAL. KNOW WHAT YOUR WEATHER WILL BE.
- o WEIGHT LOSS IS A DANGER SIGN IN THE DESERT. DO NOT USE THE DEPLOYMENT TO SWA AS AN OPPORTUNITY TO START A DIET.
- o AVOID COMPLICATION OF HEAT ILLNESS; CONTROL DIARRHEAL AND INSECT-BORNE DISEASES THROUGH CONSTANT ATTENTION TO FIELD SANITATION AND INSECT CONTROL PRACTICES.
- o SECURITY OF WATER SUPPLIES TO PREVENT LOSS, SABOTAGE, OR CONTAMINATION IS AN ESSENTIAL CONCERN.
- o INSTITUTE A BUDDY SYSTEM TO WATCH FOR EARLY SIGNS OF DISTRESS IN THE HEAT OR COLD.
- o MAINTAIN YOUR EQUIPMENT; REMEMBER C-O-L-D:
 - C: Clean clothes are more insulating
 - O: Overheating leads to soaking of clothing with sweat which increases the risk of injury
 - L: Loose and Layered; both enhance the insulating value of clothing; layers allow easy adjustment of clothing for comfort
 - D: Dry clothing has more insulating value than wet clothing
- o THE KEYS TO SUSTAINING HEALTH AND PERFORMANCE IN THE COLD ARE TO KEEP THE EXPOSED SKIN TO A MINIMUM, WEAR LAYERED INSULATING CLOTHING AND STAY DRY.

APPENDIX A

RECOGNIZING SIGNS AND SYMPTOMS OF HEAT INJURY/ILLNESS

Heat injury and illness will be a common occurrence in the desert. There are many different signs and symptoms of heat-induced injury/illness, and this section is not intended to be a substitute for medical evaluation. It is included to alert leaders to the many levels of injury/illness and their sometimes subtle warning signs.

The full spectrum of heat illnesses and injuries can be split into several, sometimes subtly different, medical syndromes (i.e., categories). Their signs and symptoms can be seen in a wide variety of the body's systems (e.g., brain, heart, kidneys). Not all of the signs and symptoms are present in every case. A common characteristic of heat illness/injury is an impairment in a soldier's capability to sustain mission-oriented activity.

CATEGORY

SIGNS AND SYMPTOMS

HEAT RASH

"Prickly heat"-type rash most commonly found on clothed areas of the body - Can impair sweating.

HEAT CRAMPS

Increased sweating, Muscle cramps ("wandering-type" involving less than the whole muscle mass, primarily abdomen and legs and arms).

HEAT EDEMA

Swelling of hands and feet.

HEAT EXHAUSTION

Tunnel vision, Weakness, Nausea, Dizziness, Fainting, Increased (in salt-type exhaustion) or decreased (in water-type exhaustion) sweating, Muscle cramps ("wandering-type" involving less than the whole muscle mass, primarily abdomen, legs and arms), Increased Thirst, Headache, Prominent Fatigue, Vomiting, Mild changes in mental function (e.g., disorientation, irritability), Rapid breathing, Elevated rectal temperature (to 102°F).

HEAT STROKE

Can include all of the above (including increased sweating) but the signs and symptoms are more severe. A primary danger sign to observers will be frankly impaired mental functions (including coma and convulsions in extreme cases). The body will have lost its ability to regulate its body temperature and rectal temperature will be elevated to 105°F. THIS IS A MEDICAL EMERGENCY AND IMMEDIATE EVACUATION SHOULD BE ARRANGED.

ALTHOUGH MILD SIGNS AND SYMPTOMS MAY BE CONTROLLED BY REST, SHADE AND WATER, LEADERS SHOULD SEEK MEDICAL EVALUATION FOR HEAT CASUALTIES - ESPECIALLY THOSE SHOWING SEVERAL IDENTIFIABLE SIGNS AND SYMPTOMS OF HEAT INJURY/ILLNESS.

APPENDIX B

WORK-REST AND WATER CONSUMPTION TABLES

1. Tips for measurement of Wet Bulb Globe Temperatures (WBGT).

- a. WBGT measurements must be made at a point 4 ft. above ground level.
- b. If the WBGT Kit (NSN 6665-01-109-3246) is used, care must be taken to ensure that the natural wet bulb is clean, as well as wet. Sand and grit can affect the measurements made with this instrument; be sure to clean and wash it regularly.
- c. If the Wet Globe Temperature (WGT) Kit (i.e., "Botsball"; NSN 6665-01-103-8547) is used, a correction procedure is required (Ref. message SGPS-PSP, 23 May 1990):

$$WBGT = 0.8 \times WGT + 0.2 \times \text{Dry Bulb}$$

where Dry Bulb may be measured by removing the dial thermometer from the WGT Botsball and reading the air temperature after 3 minutes, (shading the sensor from direct sunlight).

2. Use of Work-Rest and Water Consumption Tables (pages B2 to B3)

- a. In contrast to the guidance provided in FM 21-10, the tables provided here contain guidance tailored for dry environments. The tables also contain guidance for a wider variety of work intensities (very light to heavy) and clothing ensembles than is normally provided.

Remember that these are average guidelines derived from a mathematical model which was developed from actual measurements in a large population of test subjects. Individual requirements and capabilities may vary widely. It is more important that leaders understand the trends (and underlying principles) presented in the tables than that they follow the guidance exactly. THE TABLES ARE NOT INTENDED TO BE A SUBSTITUTE FOR COMMON SENSE.

- b. Be aware that the charts sometimes recommend hourly drinking of larger amounts of water than can possibly be absorbed during an hour.

The maximum sweating rate (approx. 2.1 qts/hr), which is closely related to the maximum water requirement, is higher than the rate of water absorption from the gut (approx. 1.5 qts/hr). Whenever input of water fails to keep up with output of sweat the body will become progressively dehydrated. This can be tolerated for limited periods of time (at a penalty in health and performance), but eventually the deficit must be made up. LEADERS SHOULD PLAN FOR AN EXTENDED REST AND REHYDRATION PERIOD WHENEVER THE TABLES ADVISE DRINKING MORE THAN 1.5 QUARTS PER HOUR.

- c. The recommended work/rest cycle and water consumption tables are applicable only to soldiers who are:

- (1) Adequately hydrated to begin with (not dehydrated by more than 2% of body weight).
- (2) Fully acclimatized (7-12 days working in the heat).
- (3) Adequately rested (6 hours sleep the previous sleep period).

APPENDIX B

ESTIMATES OF METABOLIC HEAT PRODUCTION OF VARIOUS ACTIVITIES (for a 70 kg man)

<u>Work Rate</u>	<u>Activity</u>	<u>Watts</u>
Very Light (105 to 175) [VL]	Lying On Ground -----	105
	Standing In Foxhole -----	116
	Sitting In Truck -----	116
	Guard Duty -----	137
	Driving Truck -----	163

Light (172 to 352) [L]	Cleaning Rifle -----	198
	Walking Hard Surface/ 1 m/s No Load -----	210
	Walking Hard Surface/ 1 m/s 20 kg Load -----	255
	Manual Of Arms -----	280
	Walking Hard Surface/ 1 m/s 30 kg Load -----	292

Moderate (325 to 500) [M]	Walking Loose Sand/ 1 m/s No Load -----	326
	Walking Hard Surface/ 1.56 m/s No Load -----	361
	Calisthenics -----	378
	Walking Hard Surface/ 1.56 m/s 20 kg Load -----	448
	Scouting Patrol -----	454
	Pick And Shovel -----	465
	Crawling Full Pack -----	465
	Foxhole Digging -----	475
	Field Assaults -----	477

Heavy (500+) [H]	Walking Hard Surface/ 1.56 m/s 30 kg Load -----	507
	Walking Hard Surface/ 2.0 m/s No Load -----	525
	Emplacement Digging -----	540
	Bayonet Drill -----	616
	Walking Hard Surface/ 2.25 m/s No Load -----	637
	Walking Loose Sand/ 1.56 m/s -----	642

APPENDIX B

MINUTES OF WORK PER HOUR IN WORK/REST CYCLE

WBG	T _a	w/s	RH	DBDU				BDO w/underwear				DBDU + BDO			
				VL	L	M	H	VL	L	M	H	VL	L	M	H
82	87	2.0	20	NL	NL	NL	25	NL	NL	15	10	NL	NL	15	10
86	91	2.0	20	NL	NL	40	25	NL	25	10	5	NL	25	10	NFW
88	94	2.0	20	NL	NL	35	25	NL	20	10	NFW	NL	20	10	NFW
90	96	2.0	20	NL	NL	35	20	NL	20	5	NFW	NL	15	5	NFW
98	120	2.0	20	NL	15	5	NFW	NFW	NFW	NFW	NFW	NFW	NFW	NFW	NFW
115	120	2.0	60	NFW	NFW	NFW	NFW	NFW	NFW	NFW	NFW	NFW	NFW	NFW	NFW

KEY:

- T_a Ambient Temperature (dry bulb - °F)
- WBG Wet Bulb Globe Temperature
- w/s Wind speed in meters per second
- RH Relative Humidity
- VL Very Light (metabolic workload)
- L Light (metabolic workload)
- M Moderate (metabolic workload)
- H Heavy (metabolic workload)
- DBDU Desert Battle Dress Uniform
- BDO Battle Dress Overgarment
- NFW No Further Work

ASSUMPTIONS OF USARIEM HEAT STRAIN MODEL

- Clear Skies (full daytime solar load)
- Light Casualties (< 5%)
- Full Acclimatization of Troops
- Wind = Meters per second

IMPORTANT NOTE

This table provides, for four levels of work intensity (VL, L, M, H), the number of minutes work per hour that can be sustained. The remainder of the hour should be a rest period. This table was prepared using the prediction capability of the USARIEM Heat Strain Model. Individual requirements may vary greatly. The guidance should not be used as a substitute for common sense. The appearance of heat casualties is evidence that the safe limits of work time have been reached.

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WATER REQUIREMENTS [Quarts/Hr.]

WBGt	T _a	w/s	RH	DBDU				BDO w/underwear				DBDU + BDO			
				VL	L	M	H	VL	L	M	H	VL	L	M	H
82	87	2.0	20	1.0	1.0	1.5	2.0	1.0	1.5	2.0	2.0	1.0	1.5	2.0	2.0
86	91	2.0	20	1.0	1.0	1.5	2.0	1.0	1.5	2.0	2.0	1.0	1.5	2.0	2.0
88	94	2.0	20	1.0	1.0	1.5	2.0	1.0	1.5	2.0	2.0	1.0	1.5	2.0	2.0
90	96	2.0	20	1.0	1.0	1.5	2.0	1.0	1.5	2.0	2.0	1.0	1.5	2.0	2.0
98	120	2.0	20	1.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
115	120	2.0	60	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

KEY:

- T_a Ambient Temperature (dry bulb - °F)
- WBGt Wet Bulb Globe Temperature
- w/s Wind speed in meters per second
- RH Relative Humidity
- VL Very Light (metabolic workload)
- L Light (metabolic workload)
- M Moderate (metabolic workload)
- H Heavy (metabolic workload)
- DBDU Desert Battle Dress Uniform
- BDO Battle Dress Overgarment

ASSUMPTIONS OF USARIEM HEAT STRAIN MODEL

Clear Skies (full daytime solar load)

Light Casualties (< 5%)

Full Acclimatization of Troops

Wind = Meters per second

IMPORTANT NOTE

Amounts listed are total requirements during one hour under the conditions specified; drinking should be divided over the course of this period. Note that in those cases where the water requirement per hour is listed as 2.0, water lost to sweat is greater than maximum possible water absorption during that hour. Leaders should plan for an extended rest and rehydration period under less extreme conditions whenever the table advises drinking 2.0 quarts per hour to avoid adverse effects of dehydration. This table was prepared using the prediction capability of the USARIEM Heat Strain Model. Individual requirements may vary greatly. This guidance should not be used as a substitute for common sense.

APPENDIX B

MAXIMUM WORK TIME [minutes]

WBGT	T _a	w/s	RH	DBDU				BDO w/underwear				DBDU + BDO			
				VL	L	M	H	VL	L	M	H	VL	L	M	H
82	87	2.0	20	NL	NL	NL	72	NL	NL	52	34	NL	NL	51	34
86	91	2.0	20	NL	NL	270	66	NL	156	50	33	NL	141	49	32
88	94	2.0	20	NL	NL	160	63	NL	131	48	32	NL	123	48	32
90	96	2.0	20	NL	NL	133	61	NL	117	47	31	NL	112	47	31
98	120	2.0	20	NL	100	49	35	129	61	36	22	128	61	36	22
115	120	2.0	60	39	25	13	8	60	41	24	13	61	42	24	13

KEY:

- T_a Ambient Temperature (dry bulb - °F)
- WBGT Wet Bulb Globe Temperature
- w/s Wind speed in meters per second
- RH Relative Humidity
- VL Very Light (metabolic workload)
- L Light (metabolic workload)
- M Moderate (metabolic workload)
- H Heavy (metabolic workload)
- DBDU Desert Battle Dress Uniform
- BDO Battle Dress Overgarment

ASSUMPTIONS OF USARIEM HEAT STRAIN MODEL

- Clear Skies (full daytime solar load)
- Light Casualties (< 5%)
- Full Acclimatization of Troops
- Wind = Meters per second

IMPORTANT NOTE

This table provides guidance on the maximum number of minutes a soldier can work without incurring greater than a 5% chance of becoming a heat casualty. Leaders should plan for a prolonged period of rest and rehydration immediately following the completion of the maximum work period. Medical support should be readily available during the duration of the work period. This table was prepared using the prediction capability of the USARIEM Heat Strain Model. Individual tolerances may vary greatly. The guidance should not be used as a substitute for common sense. The appearance of heat casualties is strong evidence that effective work time limits have been reached.

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<small>1. The reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.</small>				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 1 December 1990	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE Sustaining Health and Performance in the Desert; Environmental Medicine Guidance for Operations in Southwest Asia			5. FUNDING NUMBERS	
6. AUTHOR(S) Glenn, J.F., Burr, R.E., Hubbard, R.W., Mays, M.Z., Moore, R.J., Jones, B.H., and Krueger, G.P. (Editors)				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) US Army Research Institute of Environmental Medicine, Natick, MA 01760-5007			8. PERFORMING ORGANIZATION REPORT NUMBER TN 91-1	
9. SPONSORING, MONITORING AGENCY NAME(S) AND ADDRESS(ES) US Army Medical Research and Development Command, Fort Detrick, Frederick, MD 21702-5012			10. SPONSORING, MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Prepared by the staff of the US Army Research Institute of Environmental Medicine for forces deploying to Southwest Asia in Operation Desert Shield.				
12a. DISTRIBUTION AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This technical note provides leaders of deploying troops essential information on the nature of the environmental threat to operations in Southwest Asia and summary guidance on effective individual and unit countermeasures to these threats. Included is information on the environmental problems caused by desert heat, cold, dust, sand, and wind, as well as information on the separate, and interactive, problems caused by prolonged consumption of field rations, and concurrent disease, injury and operational stress. Guidance is provided for attainment of heat acclimatization, consumption of water, use of clothing and cover, physical and mental capabilities, environmentally-tailored work-rest cycles, maintenance of adequate nutrition, practice of first aid/buddy aid, field sanitation and techniques for desert survival.				
14. SUBJECT TERMS environmental medicine, heat, cold, Southwest Asia, desert, Operation Desert Shield, water, clothing, physiology, psychology, performance, heat illness, cold injury, field sanitation, work, rest, tolerance			15. NUMBER OF PAGES 50	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UL	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT	



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